June 1, 1893.

The LORD KELVIN, D.C.L., LL.D., President, in the Chair.

Professor Alexander Pedler (elected 1892) was admitted into the Society.

A List of the Presents received was laid on the table, and thanks ordered for them.

The President gave notice that at the next meeting of the Society he would propose the Duke of York for election as a Fellow of the Society by immediate ballot, to which, as a Prince of the Blood Royal, His Royal Highness was entitled.

The following Papers were read:—

I. "On the Colours of Sky Light, Sun Light, Cloud Light, and Candle Light." By Captain W. DE W. ABNEY, C.B., D.C.L., F.R.S., P.R.A.S. Received May 9, 1893.

The author has made several comparisons of the above lights throughout the different parts of their spectra, and has been able to verify their correctness by means of templates rotating in the spectrum of electric light, as described in Part II, "Colour Photometry," 'Phil. Trans.,' 1889. It seemed, however, that it would be useful if the colours of these lights could be expressed in single wave-lengths, together with the amount of added standard white light, the latter being expressed in terms of the luminosity of the dominant colour, in accordance with the method brought before the Royal Society in 'Proc. Roy. Soc.,' 1891.

When measuring light from the sky, a beam from the zenith or other desired part was reflected through a blackened tube into a darkened room in which the colour patch apparatus ("Colour Photometry," Abney and Festing, 1886) was placed, and the image of the end of the tube was focussed on to the front surface of a cube, the front surface of which was coated with zinc white, its background being black velvet. The patch of colour from the apparatus was also thrown on the cube. A rod placed in the paths of the two beams enabled the sky light and the spectrum colour to be examined side by side. The slit in the spectrum was an adjustable one, so that any intensity of colour within limits would fall on the cube. A beam of

white light reflected from the first surface of the first prism was again reflected from the surface of a thin prism on to the cube, a rod placed in its path cast a shadow on that part illuminated by the sky light, and by suitable adjustment the boundaries of the two shadows were caused to exactly coincide. The colour was thus diluted with white light, and rotating sectors, described in other papers, being placed in the path of the white beam, enabled the dilution to be regulated.

Sky Light.—On June 27, 1892, at 2.30 P.M., the sky was a good blue, but not a dark blue, and perhaps rather milky. The slit was moved into the part of the spectrum which appeared to be near the dominant colour. The colour was diluted to approximately the required amount. The slit was shifted and the dilution altered until the two colours made a perfect match. It was found that on the standard scale of the spectrum the dominant colour was represented by 28·6, which is λ 4800. The mean value of the sector aperture was 32°, and recollecting that the sectors are double sectors the comparison has to be made with 180°. The next operation was to compare the luminosity of the whole beam of white light with that of the colour. The sectors still remained in the white; the sky light was cut off, and the rod altered till the colour and the white were alongside each other with the boundaries of the shadows touching. The luminosities of the two were compared, and it was found that the aperture of the sector was 14°. As it required 32° of white to make the dilution of the colour, it follows that 32/14, or 2·286, parts of white were required to dilute 1 part of the blue. This may be expressed thus—

$$\text{Sky light} = \lambda\,4800 + 2{\cdot}3\,\text{W}.$$

On July 4, 1892, at mid-day, the same procedure was adopted, and the dominant wave-length was again λ 4800. In this case the amount of added white was thus—

$$\text{Sky light} = \lambda\,4800 + 3{\cdot}1\,\text{W};$$

in other words, the sky was more milky.

At 4 P.M. on the same day the sky to the east, and about 30° above the horizon, was evidently slightly greener, and it was found that the colour agreed with scale No. 29·6, or λ 4834, and that it required 3 parts of white to be mixed with it.

$$\text{Sky light} = \lambda\,4834 + 3\,\text{W}.$$

On other days, with the light of the portion of the sky near the zone of maximum polarisation the dominant wave-length was found to be between these two limits, and was never found bluer, and the smallest admixture of white light was found to be 1·9.

From these measures it may be concluded that the dominant colour of a blue sky is λ 4800.

Amongst artists it is not uncommon to employ cobalt to render this colour, and in many instances this is mixed with Chinese white.

The dominant colour of cobalt was found to be at scale No. 29, or λ 4812, when illuminated by ordinary day light, whence it seems that, as far as colour is concerned, it is singularly fit for the purpose.

Sun light was compared in the same manner, but the beam was reflected from the surface of a prism into a dark room, and again diminished in intensity by placing in its path rotating sectors with very narrow apertures.

Near mid-day on July 8 the sun was very clear, the sky being free from clouds, and a strongish wind blowing from the west. Two separate sets of measures were made with an interval of an hour between each. It was found that the dominant colour was λ 4885 in both cases, and in the first set it was diluted with 5·45 of white, and in the other with 5·14 of white. This indicates that sun light contains slightly more green-blue rays than the light emitted from the crater of the positive pole of the electric light. This agrees with the spectrum measures made in "Colour Photometry."

Cloud light was next matched on days in which the sky was overcast. A comparison of the general light of the zenith was all that was attempted, and near mid-day.

It was found that it required 1 part of λ 4864 diluted with 5·5 parts of white to make a match. It will be seen that the dominant colour of cloud light lies between that of the sky and of the Sun, as might be expected, and is decidedly whiter than the sky, as might also be anticipated.

Various comparisons of sunset colours have been made, and found to range from λ 6300 up to λ 4800; in some cases it was necessary to match by means of complementary colours.

The light from a paraffin candle it was found could be very closely matched with D sodium light. The equation may be expressed as follows:—

$$\text{Candle light} = \lambda 5880 + 0{\cdot}4\,\text{W}.$$

The amount of added white varied from 0·1 to 0·5, and it is in this part of the spectrum that a large number of separate observations are required in order to get a good and fairly trustworthy mean.